Power Line Hazard Awareness

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Chapter 1
Power Line Contacts in Construction

Introduction

Every year hundreds of construction workers are killed or injured by overhead and underground power lines. In this chapter you will meet John, a worker who will introduce the tragedy of a power line contact. Next, the human losses that occur in construction will be presented. This section will end with a discussion of two common myths surrounding power lines and how the body responds to electricity.

The Silent Killer

It's hard to imagine life without electricity. It powers the alarm clock, gives life to the TV, provides the energy to drive a variety of tools. Electrical power, properly contained and controlled, is the lifeblood of our world. Dishonor it by not understanding it, or by not paying attention to it, and it can kill.

This program is about overhead and underground power lines. For electrical fatalities in the construction industry, power lines are the number one killer. Each year hundreds of workers are needlessly killed or injured. These accidents could have been prevented. How do these accidents happen? Let me introduce you to John.

John was a hard worker. In his first few months at Jacobson Brothers Material Supply Company, he worked at the warehouse and later was promoted to material delivery. John was eager to deliver materials - anything to get out of the boring warehouse job.

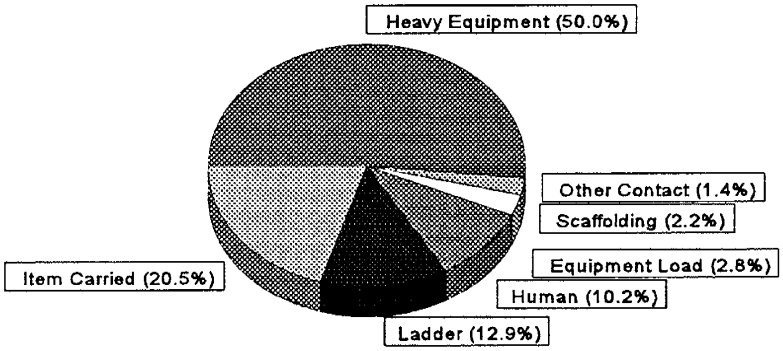
His first delivery was a load of rebar to an industrial project. Another driver warned him about the overhead power lines in the area, but he wasn't too concerned. John knew that Kyle would be there to help out. Besides, John was pretty sure that all overhead power lines were well-insulated.

When John got to the construction site, he was directed to the lay down area by site security. To unload the rebar, a picker was being used. With John on the truck handling the rigging, and his co-worker Kyle on the ground, they were able to make good time unloading the truck. During the entire process, no one paid much attention to the power lines that were directly overhead.

As the last load was being carried off the truck, the crane operator had to boom out to reach the place where Kyle stood. Just as Kyle reached out to guide the load down, the boom tip hit the power line. In a bright arc and a lot of smoke Kyle was knocked to the ground. It happened so fast that nobody could have warned him. Local EMS airlifted Kyle to a nearby burn center where he later died.

Figure 1: Power Line Contacts - U.S.

OSHA IMIS, 1985-1994

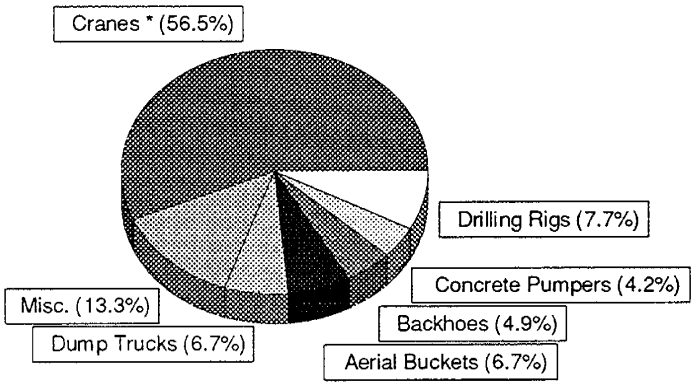


The Tragic Losses

Fifty-five construction workers are killed each year by electrocutions from overhead and underground power lines. Thousands suffer from the most painful burns you can imagine. The electricity can actually cook you from the inside. The scars from these burns will never go away. According to one major insurance carrier, the average claim cost for power line electrocutions is over $550,000. Fortunately, power line contacts are preventable.

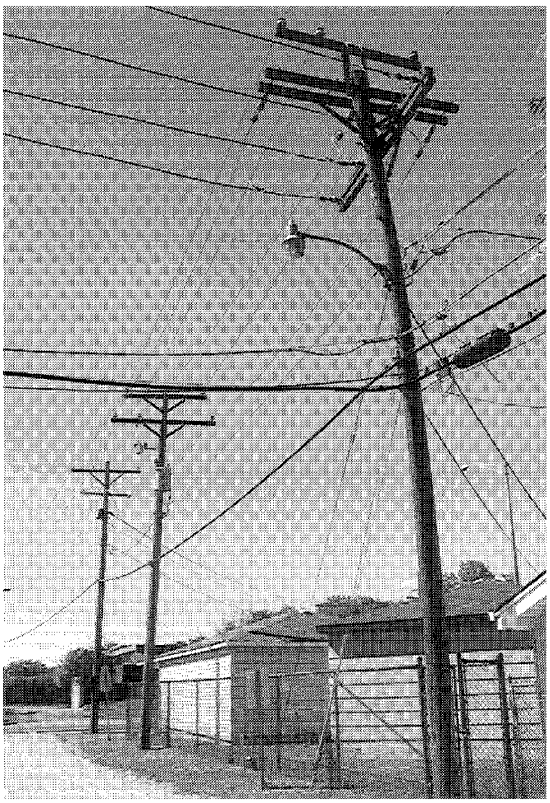
Figure 2: Heavy Equipment Contacts

OSHA IMIS: 1985-1994



* Cranes include: mobile cranes, boom-trucks and shovels

Where and how are these contacts occurring? Let's look at the best available information. Throughout the U.S. between 1985 and 1994, 509 power line contact cases were reported to the Occupational Safety and Health Administration (OSHA). A majority of these cases resulted in the death of at least one employee. A few cases resulted in three or more workers receiving electrical burns and other injuries requiring their hospitalization. The leading category of initial contact involved heavy equipment (cranes, drilling rigs, backhoes, etc.). Contacts by long-handled tools and other items carried by workers accounted for the majority of electrocutions (Refer to Figure 1). Contact between ladders carried or set up by workers and power lines, and direct contact between workers and power lines also accounted for a significant number of electrocution injuries and deaths. Of heavy equipment contacts, the majority (56.5 percent) involved cranes. Drilling rigs, aerial buckets, backhoes, and concrete pumps were also involved in power line contacts (Refer to Figure 2).

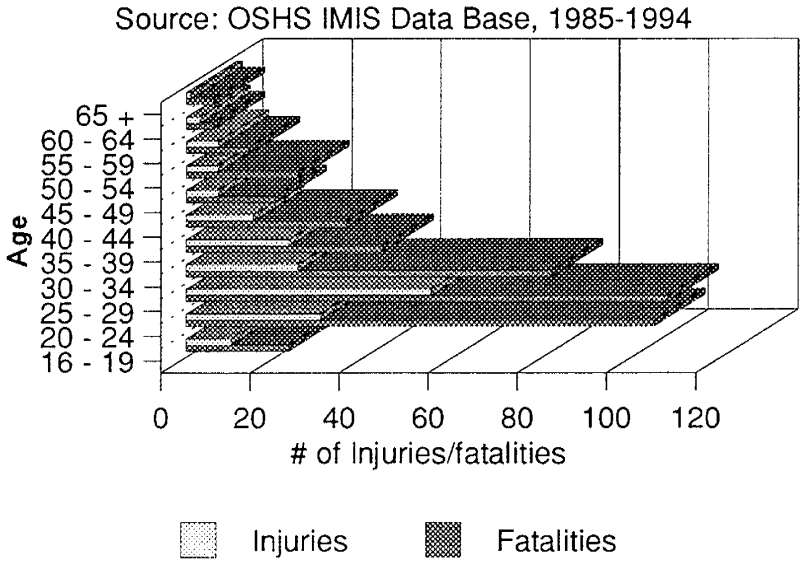


Overhead Distribution Lines

Over 90 percent of power line contacts involved overhead distribution lines. These lines are the same ones that run through our neighborhoods and through our job sites. The drop-down services from the pole to the house and the high power transmission lines that run from the generating station to the substations only account for 7 percent of all contacts.

Statistics show that over half of the construction workers who were injured or killed from power line electrocutions were between the ages of 20 and 35. (Refer to Figure 3)

Figure 3: Injuries/Fatalities



Some types of construction companies contact power lines more often than others:

- **Roofing, siding and sheet metal contractors** (9.3 percent)
- **Tree trimming contractors** (8.5 percent)
- **Water, sewer, pipeline and communication contractors** (7.9 percent)
- **Painting contractors** (7.3 percent)

The root cause behind these contacts is not always clear. However, in many fatality investigations, workers just didn't pay attention, or didn't really take the power lines seriously. We all grew up around deadly power lines. Since they

are so common to us, we take them for granted and don't treat them like the weapons they can be. This is a serious mistake which is fueled by two common myths. The first myth is that power lines don't carry enough power to kill and the second is that overhead power lines are well-insulated.

Myths and Realities of Power Line Contacts

Let's look at the first of these common myths.

"Overhead power lines don't carry enough power to hurt you."

Overhead power lines can carry voltages ranging from 120 V to over 700,000 V. For a shock to occur, a path to the ground must be created for the current. If your body touches a power source, the electricity will attempt to travel through your body to the ground, or to a power source with a different electrical potential. Because of resistance in our bodies, the path taken by the current heats up and burns the body tissue inside of us. The electricity leaves the body violently, often blowing a hole in the sole of the foot or other body part where it leaves. These are called "exit wounds".

"Overhead power lines are well-insulated."

Overhead power lines are not insulated. Any covering you see on a power line is generally there for weather protection, not insulation. If you touch a power line, whether covered or bare, you could die.

What happens when a person is shocked?

Electrical injuries are caused by electricity and heat. When an electrical current passes through the body, a worker will feel a tingle from 0.5 to 1.0 milliamps (mA). At levels between 11 and 16 mA the worker can't let go. At 60 mA, the heart can stop. It is estimated that muscle damage due to electrocution occurs at levels of 1,500 mA and greater (Table 1).

Table 1

Threshold Effects of Electrical Power

Response	Threshold Current
Perception	1.0 mA (M)
	0.5 mA (F)
Let-go	16 mA (M)
	11 mA (F)
Ventricular Fibrillation	60 mA (M,F)
Muscle Damage	1,500 mA (est.)(M,F)

M = male, F = female

Source: Lee, Gottlieb and Krizek.

Many power tools operate at amperages ranging from two to four amps (2,000 - 4,000 mA). Therefore, if a short occurs and the grounding conductor is poor or non-existent, the worker may not be able to let go of the tool. If the amount of current passing through the body is high enough, the heart can stop and muscle damage may occur.

Depending on the current levels and length of exposure, the effects of heat generated from the electricity will vary. If the current is high enough, temperatures exceeding 1,800 degrees Fahrenheit can be generated. At this level, the skin would vaporize instantly.

As soon as an electrocution occurs, a worker's life and the lives of family and friends change forever. Depending on how serious the injuries are, the worker may have to go through a long recovery period which can include surgical operations, physical and occupational therapy and counseling. This doesn't even address the psychological, social and financial stresses that the worker's family will experience.

Summary

Electrocutions from power lines are devastating. Every year hundreds of workers are injured or killed. More than half of the workers killed are between the ages of 20 and 35. A majority of injuries and deaths involve overhead power

lines. Contrary to what many people believe, overhead power lines do carry enough electricity to kill and they are not well-insulated. The tragic results of a contact can devastate a worker's family. Now that we understand some of the sources and consequences of power line electrocutions, let's look at the equipment involved in these contacts.

Review I

1. Ninety percent (90%) of power line contacts involve what type of lines?

    a. Drop-down services
    b. Distribution lines
    c. Transmission lines

2. Overhead power lines don't carry enough power to hurt you.

    True or False?

3. Overhead power lines are well-insulated.

    True or False?

4. Do the following contractors experience a large number of injuries and fatalities from power line contacts?

    a. Roofing, siding and sheet metal contractors - Yes / No
    b. Excavation contractors - Yes / No
    c. Painting and paper hanging contractors - Yes / No
    d. Masonry contractors - Yes / No

5. The most common type of heavy equipment to contact overhead power lines is the _____.

Chapter 2
Learning From the Past

Introduction

The leading source of electrical fatalities in construction is overhead power lines. The crane is the type of equipment which most often contacts overhead power lines. In this chapter, you will learn how cranes and other high-reaching equipment are contacting these lines. Ways to prevent power line contacts and preventive technologies will also be discussed.

Cranes

Of power line fatalities in the U.S. from 1985 to 1994, overhead contacts accounted for 93 percent of the injuries and deaths. The most common type of equipment involved was the crane.

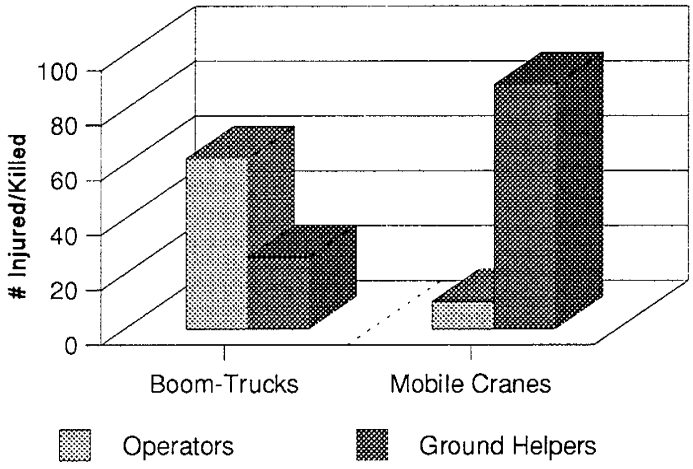
Mobile Hydraulic Crane (Picker)

When a crane contact occurs, the crane almost always hits the overhead line with its boom or load line. The resulting injury or death depends on what type of crane is involved.

Cranes found on job sites generally fall into two categories: mobile cranes and boom-trucks. **When a contact happens with a boom-truck, the operator is usually the one who is electrocuted. When a contact happens with a mobile crane, the rigger or ground worker is most often electrocuted.** (Refer to Figure 4) Equipment design is the reason for the difference.

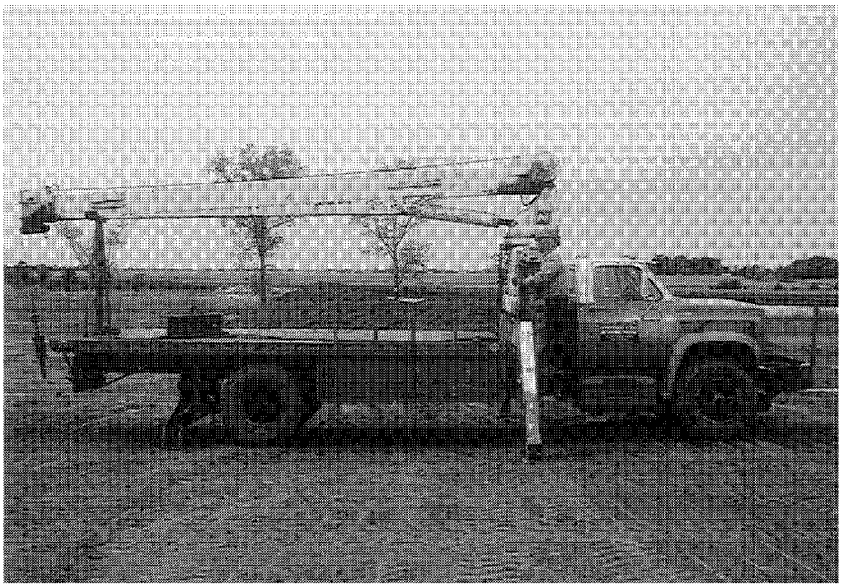
Figure 4

Accident Distribution by Worker Function (Paques, 1993)



There are two common boom-truck designs in use. One is designed with the controls for the boom located on the side of the truck chassis and the other has the controls attached to a tether approximately 20 to 30 feet long. With both designs, the operator is in direct contact with the ground. If a power line contact occurs, the boom truck operator will get shocked.

Some manufacturers now offer boom-truck designs which give the operator greater protection. Some boom-truck designs isolate the operator through an elevated platform attached to the truck chassis or the use of a radio control unit. Others use fiber optic control tethers. It's important to know that the fiber optic control units and the radio control units offer greater protection but an electrocution can still occur. Current can flow through the ground creating a shock hazard. This will be discussed in detail in a later section.



Boom-truck with elevated platform.

When a power line contact involves a mobile crane, 90 percent of the time it is the rigger who is injured or killed. The operator in a mobile crane is separated from the ground by the equipment. The rigger, however, is not. If a contact occurs while the rigger is attaching a load or guiding it with a tag line, electricity will pass through the load line to the worker on the ground.

Drilling Rigs, Aerial Buckets, Backhoes and Concrete Pumps

High-reaching equipment other than cranes account for 29 percent of power line contacts. As with cranes, the most common line hit was the overhead distribution line. The type of workers injured or killed using high-reaching equipment depended upon the type of equipment being used. For example, injuries and fatalities involving aerial baskets usually occurred to the individual in the basket. The accidents involving drilling rigs affected the ground workers. With all of the above equipment categories, except concrete pumps, the contacts happened during movement of the machinery and not during setup or take-down procedures.

When a contact involving a concrete pump happens on a job site, it often occurs during the take-down phase. It appears that during setup and use of the pump, operators are aware of the presence of overhead lines. But when the work is completed, the lines are struck while retracting and storing the boom.

Power Line Clearance

The federal OSHA requirements regarding power line hazards for cranes and other high-reaching equipment are fairly straight forward. **For lines 50 kilovolts (kV) or less, the operator must keep <u>all parts of the crane or other high-reaching equipment at least 10 feet away</u>** from all power lines. For lifting equipment, this also includes any load being carried. This safe distance, also referred to as the **line clearance distance, is the buffer zone in any direction from a power line that no equipment can enter**. One exception to this rule is if the electrical lines are de-energized and visibly grounded at the point of work.

If the lines are greater than 50 kV, then the line clearance distance is increased by twice the length of the insulator or the formula listed below.

10 feet + (0.4 inches)(# of kV over 50 kV) = Line Clearance Distance

Table 2
Line Clearance Distances for Power Lines

Voltages	Distances from Power Lines
≤ 50 kV	10 feet
200 kV	15 feet
350 kV	20 feet
500 kV	25 feet
650 kV	30 feet
800 kV	35 feet

In order to use the formula, a contractor must know the <u>exact</u> voltage of a power line to calculate line clearance distance. This can be done by calling the utility company that owns the line. But many contractors don't do this. It's difficult to figure out the exact voltage of an overhead power line just by looking at it.

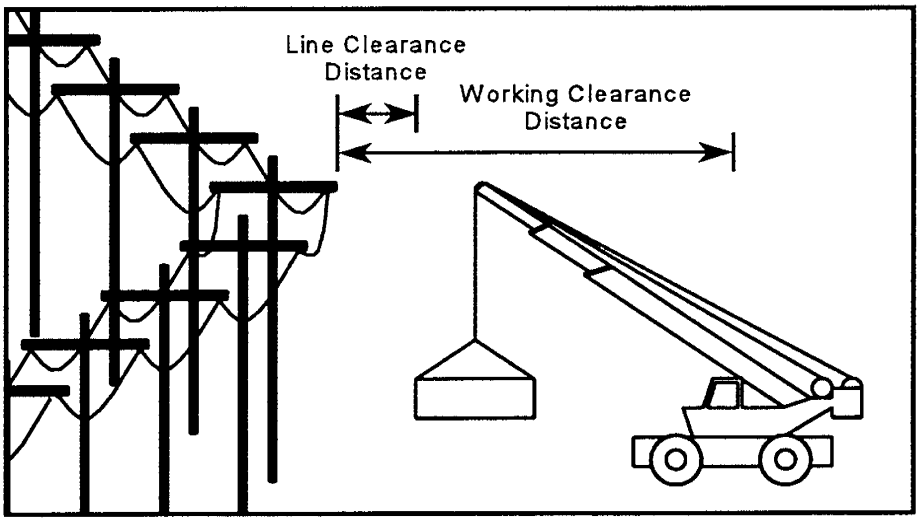
A good rule of thumb for deciding the line clearance distance is: If the overhead power line is 50 kV or less, then stay at least 10 feet away. For everything else, keep at least 35 feet away.

> If the overhead power line is 50 kV or less, then stay at least 10 feet away. For everything else, keep at least 35 feet away.

The distribution lines like the ones that commonly run through residential neighborhoods are all under 50 kV. If you're not sure that the line running through your job site is less that 50 kV, then 35 feet is as close as you should get.

Safe Working Clearance

The line clearance formula only computes the line clearance distance. It doesn't determine the safe working clearance - the closest distance that you can place a piece of equipment without crossing into the power line's buffer zone.



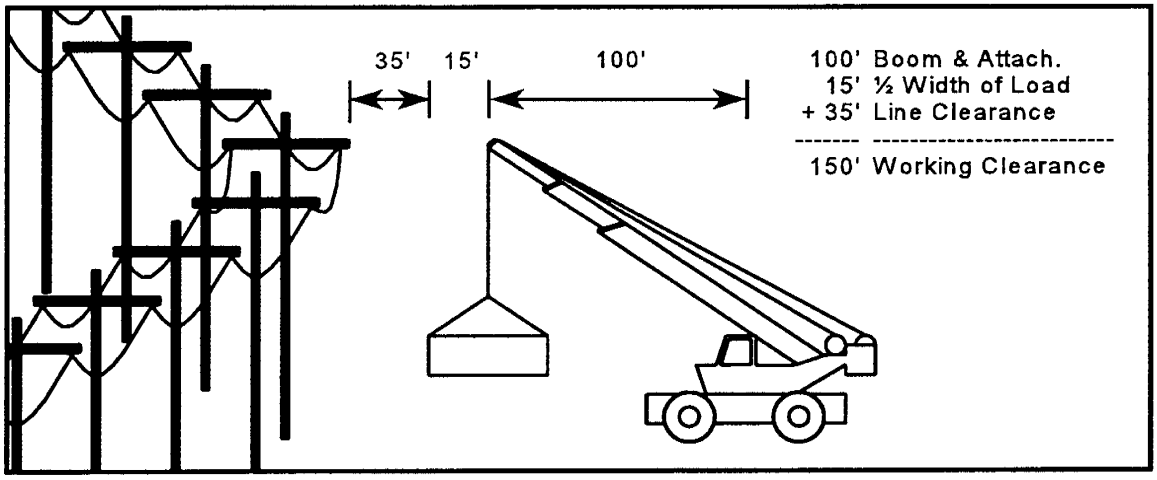
To make sure your equipment won't hit the power line, you must determine how close you can safely be to that line. How do you do this? By calculating the safe working clearance you need.

The working clearance is determined by adding the farthest reach distance of the equipment, half the horizontal distance of the widest object to be carried (if applicable) and the required line clearance for the closest power line. Then, you measure from the center point of your equipment to the power line. If you end up on the equipment side of the line or directly underneath it, you're far enough away. If you pass underneath the power line before reaching the safe working clearance distance, you're too close and other measures will need to be taken.

Determining Safe Working Clearance

For example, let's say that you need to use a crane with 100 feet of horizontal reach (this includes all attachments to the boom) to move concrete form work (30 ft. by 20 ft.) at your job site. Nearby is an overhead power line that doesn't look anything like the distribution lines commonly seen in residential communities (i.e. less than 50 kV). So, the distances you need to add together to find the safe working clearance distance are:

100 feet	(length of the crane boom and all attachments)
15 feet	(half of the width of the concrete form work)
+ 35 feet	(line clearance for power lines with unknown voltages)
150 feet	safe working clearance



Other Preventive Measures

So what do you do if you find out that the equipment you're operating will be closer than the safe working clearance distance mentioned above? There are several options:

1. **Have the power company de-energize the power line.**
2. **Have the power company move the power line beyond the safe working clearance distance.**
3. **Use barrier protection.**
4. **Use warning lines with flags.**
5. **Use an observer.**

Let's look at each of these.

De-energizing the Line

De-energizing and visibly grounding the line should be the first option considered for protecting workers. **By eliminating the source of the electrocution hazard, the danger is eliminated.** There is one important point to keep in mind with this option. **Only power company personnel can de-energize a power line.** The contractor must ask the local utility to de-energize it. The utility may need several weeks to comply with your company's request, so the work should be appropriately planned.

Moving the Line

Moving the line beyond the safe working clearance distance will reduce the hazard for the work crews near the line. However, like de-energizing the line, **only power company personnel can move a power line.** Only the utility that owns the line can move it. Again, the utility may need several weeks to comply with the request, work should be planned appropriately.

Barrier Protection

Another option that your company may use is barrier protection. **The barrier prevents physical contact between the high-reaching equipment and the power line.** The barrier can be made of any material that is non-conductive

and not attached to the high-reaching equipment. The most common type of barrier is the insulated sleeve which is attached directly to the power line.

If insulated sleeves are used, they can only be installed by power company personnel. Also, the sleeves must be appropriate for the type of work you will be doing. It is important to remember that with an insulated sleeve, you still should not work any closer than the line clearance distance. Workers have been electrocuted when insulating sleeves have failed and the equipment they were working with became electrified.

On many sites, power lines cross over temporary and permanent roads. Even though work may not be done around these lines, contacts can occur as equipment passes under them. To address this problem, your employer can use physical barriers called "goal posts" or "rider posts." This type of barrier requires equipment operators to lower their equipment below a physical barrier placed under the power line. What's nice about this barrier is that it's an active reminder of the overhead electrical line.

Warning Lines with Flags

Using warning lines with flags is a way to visibly show were a power line's buffer zone is located. This option requires the installation of flagged warning lines to the side and below the power line. The warning line must be made of non-conductive materials. When an equipment operator moves near the power line, the warning line will mark the line clearance distance. The warning lines should not be attached to the utility line or pole. Placement of the warning lines can be achieved with the use of wooden poles. Remember, this system doesn't allow you to work any closer than the line clearance distance.

Using an Observer

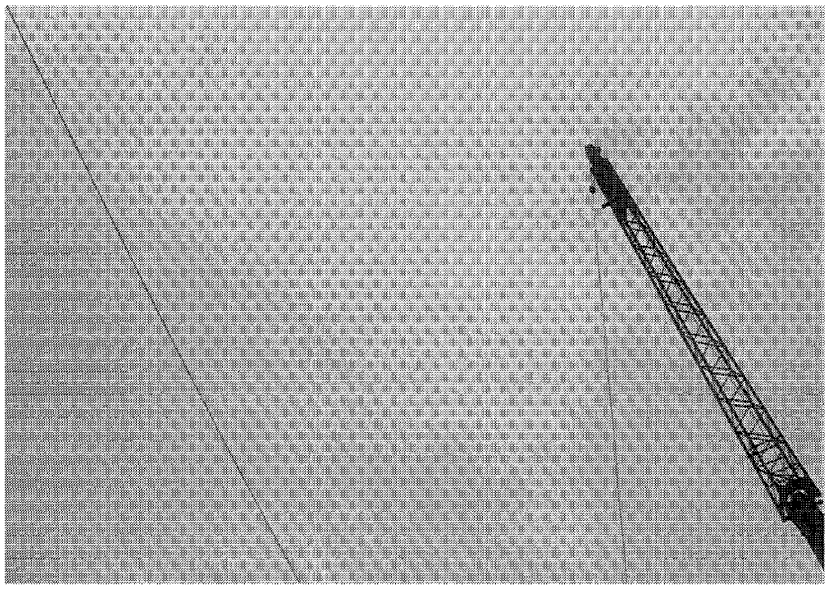
The designated observer is assigned to monitor the distance between the high-reaching equipment and the power line. If the equipment nears the power line's minimum clearance distance, the observer warns the equipment operator. For this to work, the observer must be able to accurately judge the distance between an energized power line and the high-reaching equipment. This is difficult for most people.

Therefore, when using an observer the contractor should do the following:

- Position the observer with a clear view of the overhead power line. This will usually be below the line but to one side of the high-reaching equipment for horizontal clearance, and off to one side of the power line and equipment for vertical distance.

- Don't give the observer other responsibilities that may create distractions.

- For horizontal clearance, mark off on the ground with caution tape the appropriate distance from the power line so that the observer knows the exact location of the line's clearance distance. For cranes, as the load approaches the caution tape, the observer will know that the boom tip is nearing the power line's buffer zone. It's important that the observer be aware of any additional attachments to the crane boom. These attachment(s) may cause the crane's boom tip to project out beyond the location of the load line.



View from ground of horizontal clearance distance.

Protective Technologies

The protective technologies available for high-reaching equipment are limited in use and application. All are designed primarily for cranes, though some may be applied to other high-reaching equipment. For applications other than cranes, the contractor must consult the manufacturer of the equipment.

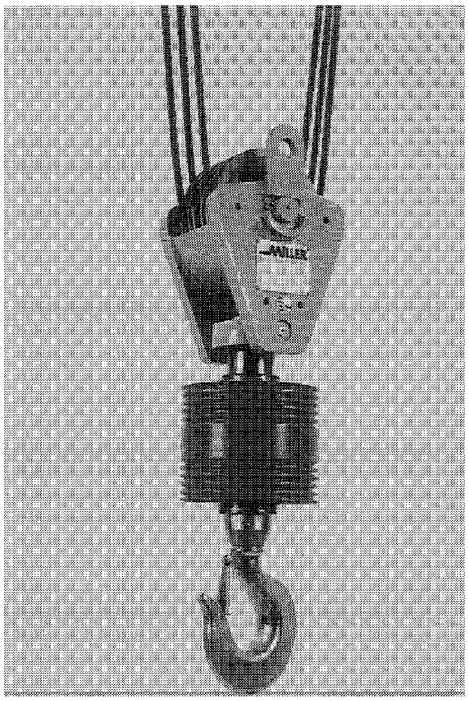
Available technologies include:

1. **Proximity devices**
2. **Boom-cage guards**
3. **Insulated links**

Proximity devices are designed to warn the crane operator when any part of the boom is moved too close to an overhead line. It is possible to get false readings with these devices, so the contractor must be familiar with the limitations of the equipment. Additionally, even when this device is being used, the operator must maintain the proper clearance distance from the power lines.

Boom-cage guards are designed to provide a protective cage that shields the boom from the power line. If a power line contact occurs with a boom-cage guard, it will prevent the boom from becoming energized thus protecting all workers involved. The drawback of this technology is that it only protects the portion of the boom covered by the cage-guard. It is still possible for contacts to occur on other parts of the boom, the load line and the load. **Additionally, the operator can't work closer to the line with the guard installed.**

Insulated links are used between the crane hook and the load. They are insulated linkages that connect the load line to the crane's lifting hook. If a power line contact occurs, the linkage is designed to prevent the electricity from passing to the load. The entire structure of the crane, however, is not protected and will remain energized. Therefore, it is possible for the rigger to be protected, but any worker near the crane body may be electrocuted from the current passing through the ground. Also, the operator can be electrocuted when stepping down from the equipment. It's important that the insulated links are regularly inspected and properly maintained to avoid premature failure of the product.



Insulated link courtesy Miller Products, Inc.

When insulated links are used, it is important to understand that the operator still cannot allow any part of the crane or load inside the power line's minimum clearance distance. **An insulated link doesn't allow an operator to work closer to the line.**

Summary

In this chapter you learned that of all power line contacts, overhead power line contacts result in the greatest number of injuries and deaths. Cranes are involved in the greatest portion of power line fatalities. The best way to insure that no contact occurs is to maintain a safe working line clearance distance from the power line. If you must work where you might accidentally cross over the minimum line clearance distance of a power line, the contractor should use preventive measures. These include contacting the power company to de-energize or move the line, using an observer, using barrier protection or using warning lines with flags. Other options are insulated links, proximity devices and boom-cage guards. With these technologies, however, the operator still must maintain the appropriate clearance distance from the power lines.

You've seen that high-reaching equipment accounts for the largest part of the power line contacts. In the next chapter, you will learn about other activities and equipment involved with power line electrocutions.

Review II

1. Operators are more likely to be injured than ground workers when mobile cranes are being used.

   True or false?

2. Operators are more likely to be injured than ground workers when boom trucks are being used.

   True or false?

3. Power line contacts involving concrete pumps seem to occur during the take-down phase.

   True or false?

4. If a power line is not de-energized, and barrier protection has not been installed on the line, the closest distance that a crane boom or load line can (safely) be to a power line less than 50kV is _____ feet.

5. What is a good rule of thumb for determining the line clearance distance?

6. The safe working clearance distance is the closest that a piece of equipment can be to an overhead power line so that the farthest reach of the equipment will not be closer than the line clearance distance.

   True or false?

7. Measures which can be used to prevent power line contacts include:

   a. _____
   b. _____
   c. _____
   d. _____
   e. _____

8. Any worker can de-energize an overhead power line so long as it is done carefully.

   True or false?

9. The designated observer who is assigned to monitor the power line clearance distance must not be given other duties/activities which will distract him/her.

   True or false?

10. Protective technologies such as proximity devices, boom-cage guards, and insulated links allow the crane operator to work closer than the line clearance distance.

    True or false?

Chapter 3
More Lessons From the Past

Introduction

Contact between high reaching equipment and power lines create the largest portion of electrocution fatalities. However, many other types of equipment and activities can be involved in electrocution injuries and deaths. In this chapter, you will learn about power line fatalities involving material handling and storage, ladders and excavation activities. The causes of these deaths and preventive measures will be discussed. Emergency procedures in response to a contact will be presented at the end of this section.

Material Handling

Material handling is such a common activity on a job site that most workers don't give it a second thought. Equipment or supplies must go from point A to point B and how that occurs doesn't matter. It just has to be done. The trouble is that a lot can happen in this seemingly simple process.

As seen in Figure 5, electrocutions involving material handling make up over 20 percent of all power line contacts. Items carried ranged from bull floats to scaffold parts. Only one pattern is apparent: workers who were injured or killed carried conductive equipment into the buffer zone of a power line.

Material Storage

A common problem on construction sites is a lack of areas suitable for material storage. Most of the open space is taken up with equipment, trailers and general construction activities. This makes finding a place to put material a real hassle. Since most construction activity does not occur directly underneath overhead power lines, that area appears to be an ideal out-of-the-way place for a

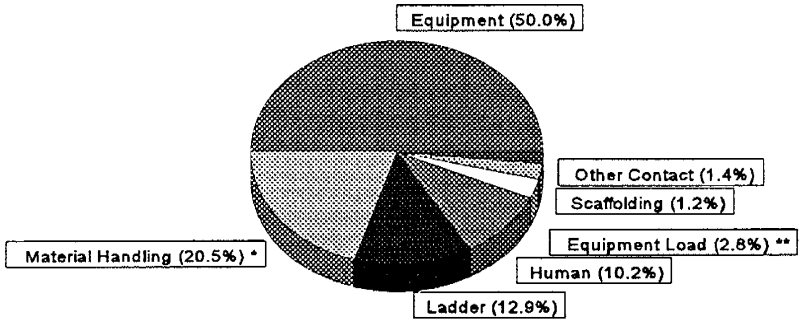
lay down area. However, **it has been shown that the greatest risk for a power line contact occurs during the unloading or movement of materials under power lines.** Typically, when unloading materials from trucks and flatbeds, there is a lot of activity and multiple lifts going on and this can cause workers to forget about the overhead hazard. Therefore, it is important that this area be banned from any material storage. To prevent this from occurring, use caution tape and signs to cordon-off these areas and keep workers and equipment away.

Ladders

The most common type of ladder involved in overhead power line electrocutions is the metal extension ladder. One study conducted by the Consumer Product Safety Commission (CPSC) on ladder electrocutions found that of 54 fatality investigations over an eight year period, all involved metal ladders (CPSC, 1989). When ladder contact occurred it was usually during erection, lowering or relocation.

Figure 5: Power Line Contacts - U.S.

Source: OSHA IMIS Data Base, 1985-1994



* Material handling refers to all items carried by hand.
** Equipment load refers to items carried by lifting equipment.

Reducing the Risk of a Contact

The most important thing you can do to prevent a contact is to always be aware of the location of overhead power lines. Also, you've got to be sure that you maintain the minimum clearance distance. Remember, for

the line 50 kV or less, -- 10 feet. For anything else -- 35 feet. Always count the length of any tools or materials you are using. For any work near a power line other measures can also be taken:

Other options are:

1. **De-energizing and visibly grounding the line.** (This can only be done by utility company personnel)
2. **Moving the line a safe distance away.** (This can only be done by utility company personnel)
3. **Installing insulating sleeves.** (This can only be done utility company personnel) With this option you still should not work closer than the clearance distance.
4. **Using non-conductive materials/tools.** With this option you still should not work closer than the clearance distance.
5. **If using a ladder:**
   a. **Use only a non-conductive ladder.**
   b. **Don't carry or move an extension ladder fully-extended.** Retract it first.
   c. **Get help when handling an extension ladder to maintain control.**
   d. If possible, with this option **you still should not work closer than the clearance distance.**

Excavation Activities

Excavation work has also been found to result in electrocution injury and/or death. When a death occurred, the worker was usually operating a powered hand tool or was in direct contact with the digging machinery. Calls were rarely made to locate any underground utilities. Millions of dollars are lost each year to power outages and utility damage. The lesson is that when any excavation work needs to be done...you must call before you dig.

Call Before you Dig!!!

In many areas, the contractor must call at least 48 hours (two business days) before digging. See if your state requires a longer lead time. The ultimate responsibility for any damaged underground utility falls on the contractor doing the work. So if you still have a suspicion, even after the utility lines have been located and marked, hand-dig with extreme care. It's also important to know that many cables are buried side by side. So, after finding the underground cable, if you are unsure about the presence of additional cables, continue to hand-dig.

Underground locator technologies are commercially available to contractors. Not only are they effective for identifying underground power lines, but many can also be used for locating other utilities. For contractors who do a lot of digging, the cost of one of these devices is far less than the price of repairing the damage from an underground hit.

Before doing any digging, your employer must call the local one-call system to locate any underground utilities.

What to Do If You Hit a Line

Unfortunately, power line contacts do occur. Your response is critical. Let's learn how to respond to two common emergency situations.

Power Line Contact with Worker Isolated

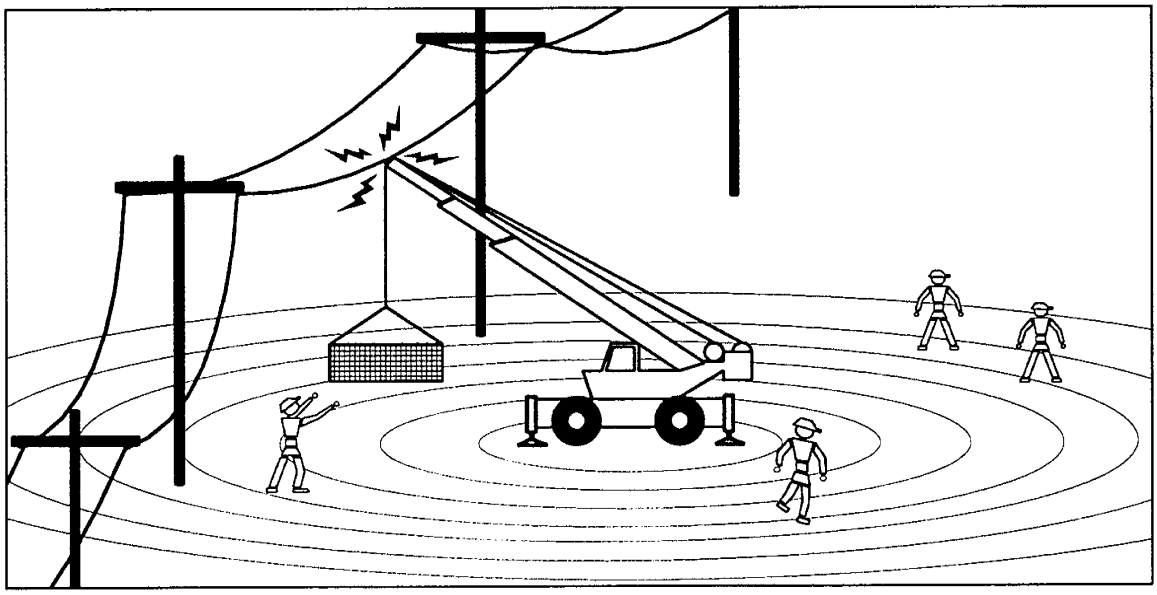
Power line contacts involving equipment like mobile cranes and backhoes generally do not result in injuries to the equipment operator. Injuries and death are usually experienced by the riggers or other workers standing near the equipment. The reason for fewer injuries to operators is equipment design. If a contact occurs, the operator is at the same potential as the equipment. With a boom-truck, however, the operator is usually in contact with the ground. The shock occurs when the current passes through the operator on its path to the ground.

When the operator is isolated in the equipment cab and contacts a line, he/she should wait on the equipment until the line is de-energized by the power company. Under no circumstances, except for an extreme case such as the equipment catching fire, should the operator leave the equipment. If a power line contact occurs, stay on the equipment. Don't leave unless the equipment is on fire.

If a power line contact occurs, stay on the equipment. Don't leave unless the equipment is on fire.

The operator must first jump clear of the equipment, landing on his/her feet. Care must be taken to not touch any part of the equipment when contacting the ground. If he/she touches the equipment and the ground at the same time, an electrocution injury will result.

The operator must then shuffle in very small steps away from the energized equipment. This should be done because after a power line contact, the current flows outward through the soil in a ripple pattern. Areas of high and low potential circle the energized equipment like ripples in a pond after a stone hits the surface. If the operator steps from an area of high potential to an area of low potential, electricity can flow through the operator's legs causing injury or death.



Current can flow outward through the soil in a ripple pattern from the equipment in contact with a power line.

If you must leave the equipment:

1. **Jump from the equipment, keeping feet together.**
2. **Shuffle your feet with <u>very</u> small steps.**

The current flowing through the ground is also the reason why other workers in the area of the energized equipment must always stay away. If they walk up to the equipment, they will get shocked and probably die. Fatality reports have documented the deaths of many workers who were not touching the energized equipment but standing nearby.

Power Line Contact with Worker <u>Not</u> Isolated

A power line contact directly involving a worker is a terrible experience. When one occurs, the only thing that co-workers can do is to wait until the power is turned off by the utility company. **Under no circumstances should any worker go near the injured employee.** Remember, the power flowing

through the ground could easily injure and kill you. Then, instead of one victim, there will be two. Therefore, no matter what you think or feel, *you can't go near the energized worker until you know the power is off.* Remember, you can't be sure that the power is off just by looking at the victim. Rely only on emergency medical rescue professionals and/or utility company personnel to assist with rescue.

Controlling the Power Line Hazards

Your employer should do things to reduce the likelihood of a power line contact. These actions should include:

➤**Surveying the job site** for all overhead and underground power lines
-If you think that there is a power line which your employer doesn't know about, tell your supervisor immediately.
➤**Identifying the activities** that will be near the power lines
➤**Eliminating/reducing the risk of contact** by:
-moving the activity
-changing the activity
-de-energizing the line(s)
-moving the line(s)
➤**Preventing possible contacts** by using:
-barrier protection
-an observer
-warning lines with flags
-protective technologies
-non-conductive tools/materials

Summary

In this chapter we have discussed the power line hazards involving material handling and storage, ladders and excavation activities. With material handling and storage, and ladder usage, you must be aware of where the power lines are and to stay out of the overhead power line's buffer zone. You must never use a metal ladder near a power line. For excavation activities, the contractor must call before digging. When in doubt, contact the utility directly and always hand dig with extreme care around an underground cable. More buried cables may be present. If a power line contact happens, don't go near the equipment or worker

involved until the power is turned off by the utility company. If you are on the equipment, don't leave it unless it is on fire or some other life threatening emergency makes it necessary to leave. In such a case, jump clear, keeping your feet together and shuffle away with very small steps.

Review III

1. Electrocutions involving material handling make up over 20 percent (20%) of all power line contacts in the United States.

   True or false?

2. The most common type of ladder to contact overhead power lines is the _____ _____ ladder.

3. If using a ladder anywhere near power lines, you should:

   a. Use only a non-conductive ladder. True or false?
   b. Not carry or move an extension ladder fully extended. True or false?
   c. Get help when handling an extension ladder to maintain control. True or false?
   d. If possible, you should not work closer than 10 feet to any overhead power line. True or false?
   e. Use the power line as a convenient place to hang your tools while working. True or false?

4. When you dig, your employer must _____ before digging.

5. If an operator hits an overhead power line with a crane he should remain in the cab of the equipment until the power is turned off.

   True or false?

6. If an operator hits an overhead power line with a crane and the equipment catches on fire, the operator should jump from the equipment and run away.

   True or false?

7. If a fellow worker is in contact with an energized power line you should wait until the power is turned off before approaching the victim.

   True or false?

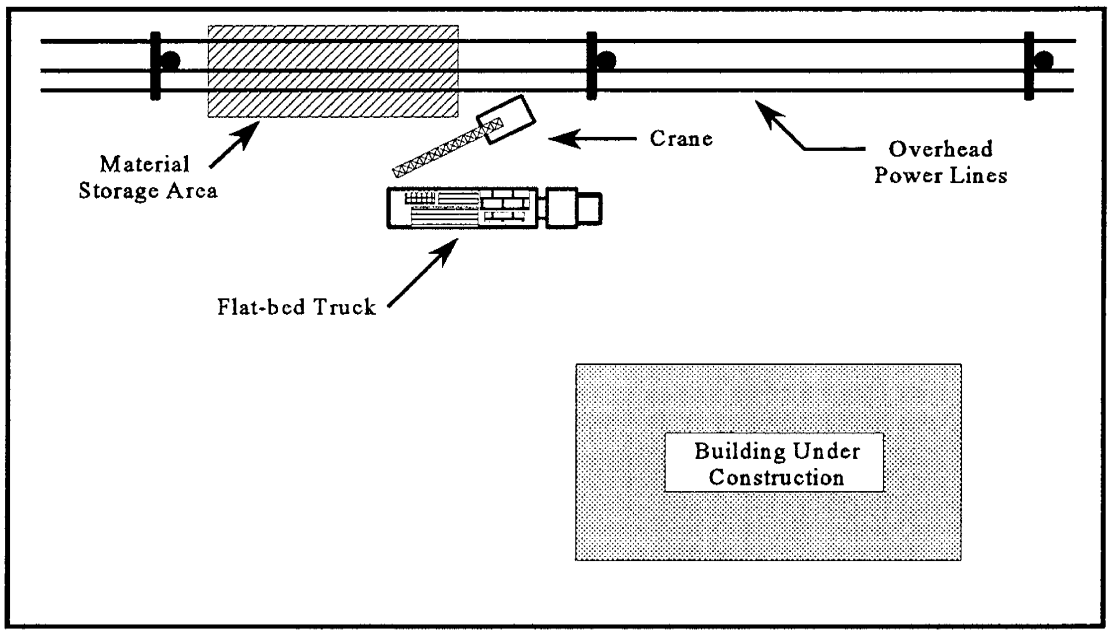
8. The area underneath an overhead power line is a good place to store material since construction generally doesn't occur there.

   True or False?

Class Problems

1. Cranes and Material Storage

In the problem below, a crane is being used to unload a flat-bed tractor trailer and place that material in a storage area directly underneath overhead power lines. The overhead power lines are 20 feet above the ground. The areas around the building under construction are open fields available for use by the contractor.



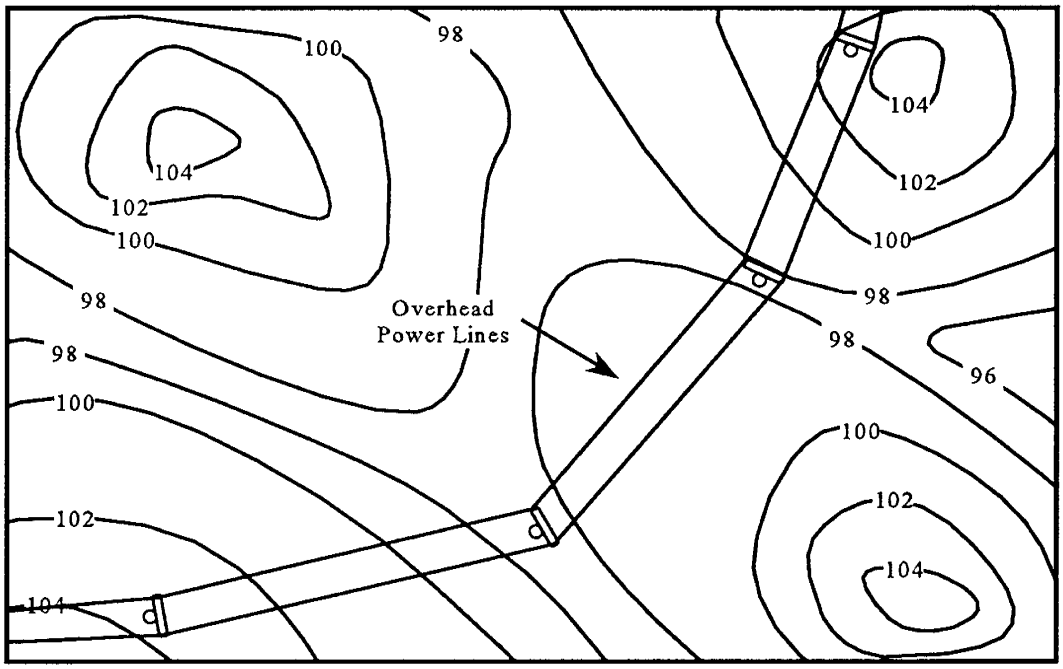
1. What are the dangerous activities/equipment in the above situation?

2. What should the contractor do to eliminate the dangers created by the location of the material storage area underneath the power lines?

3. If the construction activity required the crane to be near the overhead power lines, what different things could the contractor do to reduce the chance of a contact?

2. Dump Trucks and Other Mobile Equipment

In the problem below, the dirt contractor will bring in fill dirt to raise the low areas of the site to an elevation of 102 feet using dump trucks and bulldozers. There is between 15 to 18 feet of clearance under the overhead power lines running through the site prior to any site work.

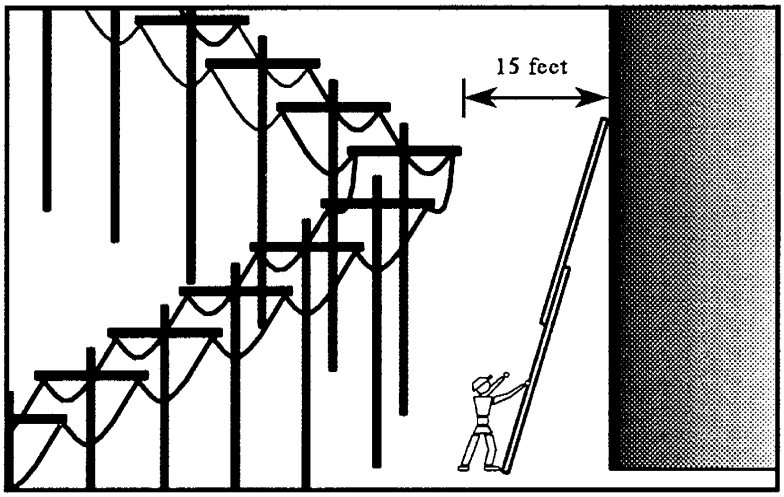


1. What are the dangerous activities/equipment in the above situation?

2. What can the contractor do to reduce or eliminate the dangers created by the overhead power lines if the lines cannot be de-energized by the utility company?

3. Ladders

In the problem below, a worker is painting the side of a structure using a 40 foot metal extension ladder. The horizontal distance from the structure to the overhead power lines is 15 feet.

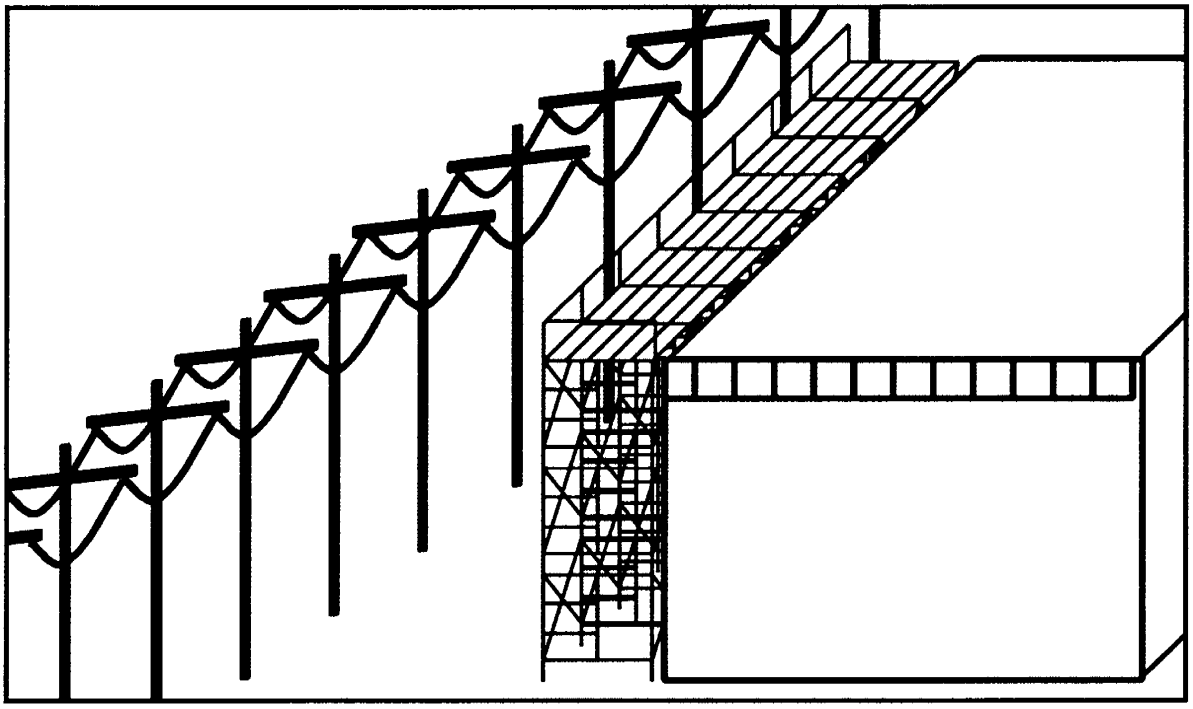


1. What is the dangerous activity in the above situation?

2. What should the worker do to reduce the risk of a power line contact?

4. Tool Usage

In the problem below, concrete finishers will be using bull-floats to smooth the surface of a poured concrete roof for a 1-story structure. The finishers will be working on scaffolding which is 10 feet horizontally from overhead power lines running near the building. The scaffold deck is approximately the same height as the power lines.

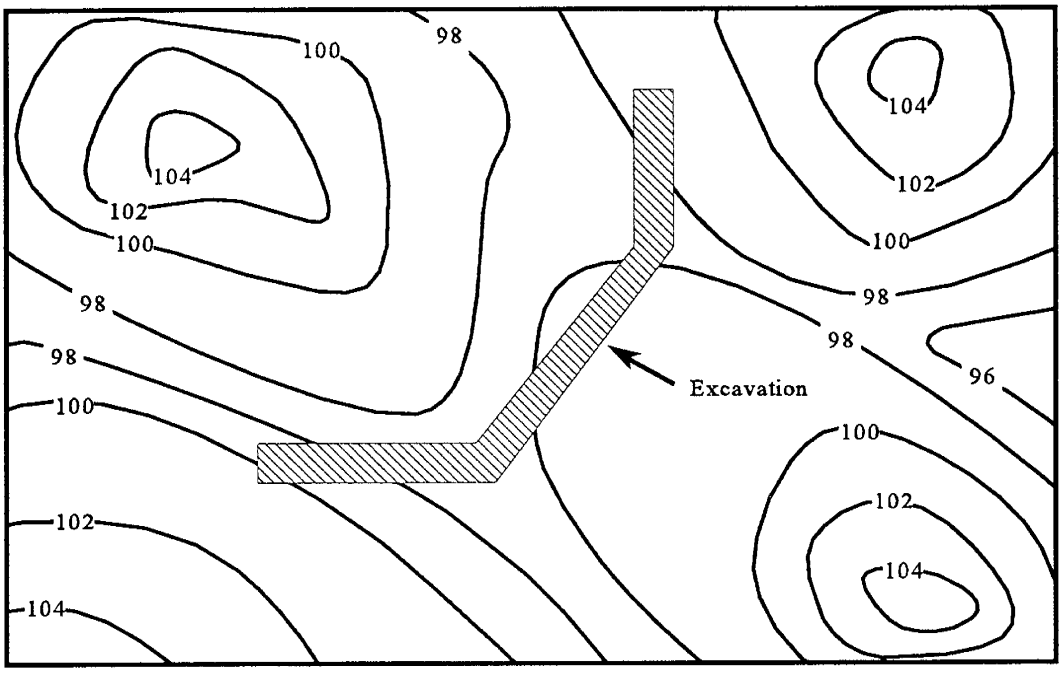


1. What is the dangerous activity in the above situation?

2. What should the contractor do to reduce/eliminate the danger of a power line contact?

5. Excavations

In the problem below, a contractor will be digging a trench (identified below) to a depth of 10 feet.



1. What is the dangerous activity in the above problem?

2. What should the contractor do prior to starting the excavation?

3. What should the workers do as the digging nears the marked underground utilities?

4. What should the worker do if he finds or suspects the existence of an unmarked underground utility?